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Informed Design of Educational Technologies in Higher Education: Enhanced Learning and Teaching

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Chapter 4

The Next Generation: Design and the Infrastructure for Learning in a Mobile and Networked World

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ABSTRACT

Focusing on intermediate and institutional levels of design for learning, this chapter explores how institutional decisions relate to design, using recent experience at The Open University as a case study. To illuminate the relationship between institutional decisions and learner-focused design, we review and bring together some of the research on learner practices in mobile and networked learning. We take a critical stance in relation to the concept of generation, which has been applied to understanding learners of different ages using terms such as net generation and digital natives. Following on from this, we propose an integrated pedagogical design approach that takes account of learner practices, spaces for learning, and technologies. The chapter also proposes future research directions focused on the changing context for learning, a distinction between place and space and an understanding of how the different levels of educational systems interact with mobile and networked technologies.

INTRODUCTION

In recent years a number of studies have investigated how new generations of students, including mature learners returning to study, draw on

a range of personal experience with online and mobile tools and services to support their learning (Bullen et al., 2009; Hargittai, 2010; Jones et al., 2010; Kennedy et al., 2008; Pedró, 2009). Although the studies show that students are often adept at using these tools and services in creative ways that benefit their learning, there are also

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strong reminders that not all members of any age-defined ‘generation’ have the same levels and extent of expertise. In particular, the younger age group is by no means homogenous in its use and understanding of technology. Nevertheless there are significant age-related changes taking place in students’ and young peoples’ use of new media and digital and networked technologies (Jones et al., 2010; Ofcom, 2009). Bennett et al. (2008) argue that although there are age-related differences they do not lead to a deficit in which teachers can be thought of as simply lagging behind their students in this regard.

The public rhetoric has emphasised the risk that, as a wave of more competent or adventurous learners (spanning all ages) forges ahead with ever more sophisticated uses of technology, taking their peers with them, there will be increasing dissonance between educators’ ideas about learning and those of their students. To assess and if necessary manage this risk, we can analyze the characteristics of learning in a mobile and networked world and provide educators, both individuals and institutions, with conceptual tools for more appropriate designs for learning. The groundwork for this has already been done (Beetham & Sharpe, 2007), with a number of conceptual tools being available for mapping mediating technologies onto the tasks they can help support (Laurillard, 2002), analyzing the implications of how people learn (Mayes & de Freitas, 2004) and learner differences (Beetham, 2007), using checklists for activity design (Beetham, 2007) and for course design (Sharpe & Oliver, 2007a), using a taxonomy of learning activities (Conole, 2007) or a typology of effective interventions for e-learning practice (Sharpe & Oliver, 2007b). However, a world in which mobile and networked technologies have gained prominence but are no longer separate entities calls for a new approach, synthesizing research and practice from these two communities to give a more holistic account of learner experience and a perspective on the implications of physical, virtual and ‘hybrid’ space.

The potential for a mismatch between the technology experience of educators and learners (Becta, 2006) is not the only tension we need to consider. Students’ experience with mobile and networked technologies is based partly on everyday interactions for social reasons or informal learning, but it is also influenced by their use of technology in previous formal settings, such as school and college, or work contexts if they are part-time workers returning to study or continuing their professional development. Therefore institutional or organisational views of how technology supports or does not support learning, and the infrastructures provided for learning, are powerful factors. Higher Education institutions are frequently driven by imperatives such as organisational strategy, including IT procurement strategies and plans for the development of their estates. When we confront this with the aspirations of university teachers to try out new technologies or new ways of using technology, it is possible to identify some overlaps, but also some areas of disjunction. We wish to argue that by building continual research on student practices with technology into the practice of teaching, we can create environments where students and teachers are in ongoing dialogue and this in turn has the potential to inform and transform institutional strategy.

This chapter provides a review of recent research relating to the use of networked and mobile technology by learners in different age groups, whilst taking a critical stance in relation to the concept of ‘generation’. Our main objectives for this chapter are the following:

- To explore how institutional factors relate to design by setting the parameters within which specific instances of design can take place
- To review and bring together research on learner practices with technology from two communities, namely mobile learning and networked learning

- To formulate implications for the next generation of design for learning in relation to new infrastructures for learning

Against a background of institutional change, illustrated through the experience of The Open University, we identify key findings from a range of studies concerning learner use of technology, including our own research, focusing primarily on use of the web and mobile technologies. We then use these findings to formulate implications for design which should be sensitive to learner practices. We also believe that institutions should embrace more open environments in which these practices can be observed, discussed, and integrated into future designs for learning, creating enhanced conditions for teaching and learning.

BACKGROUND: INSTITUTIONAL CHANGE

Much of the recent work in relation to design has focused on learning design, used in a number of somewhat different ways (Koper & Tattersall, 2005; McAndrew et al., 2006). The stance taken in the chapter is that design for learning is indirect, that is that learning cannot be designed directly but only designed *for* by providing good conditions in which learning can take place (Beetham & Sharpe, 2007; Jones & Dirckinck-Holmfeld, 2009). We explore how institutional factors relate to design for learning by setting the parameters within which specific instances of design can take place. The focus is on intermediate and institutional levels of design that sit between micro levels of design affecting day to day interactions and macro levels of design that affect broad areas of infrastructure at regional, national or global level. The chapter draws on the experience of The Open University (UK) and the implementation of the OU Virtual Learning Environment (VLE) between 2005 and 2009 (Jones, 2009; Sclater, 2008). The university also has an evolving mobile learning strategy and

engagement with the potential of social networks for learning.

By taking a single case study of institutional change the chapter examines some general issues affecting the design of an infrastructure for learning (Guryibe, 2005; Guryibe & Lindström, 2009). These include the way that the design of an institutional tool such as a VLE can impact on day to day interaction, the way that the selection of a technological platform can have a lock-in effect and the way that systematic planning at institutional level can be affected by contingent organisational factors. The chapter also examines the limits of institutional design and the impact that universal service infrastructures, such as search engines (e.g. Google™), Wikipedia®, open educational resources, cloud computing and mobile applications can have on local educational practices.

The Open University Case Study

The Open University (OU) adopted Moodle™ as the main platform when it introduced a new Open University Virtual Learning Environment (Jones, 2009; Sclater, 2008). The design of Moodle™ was based around an imagined setting: the classroom and a single academic teaching a cohort of students. The problem for the OU was that the university is based around a pedagogy of ‘Supported Open Learning’, which relies on support for individual students and groups in large distance education courses that are designed by complex course teams and delivered by a group of Associate Lecturers on separate contracts to the course team. The new platform supporting the change in infrastructure had inscribed into it a notion of how teaching and learning would be done. The Open University has program level structures which are used to integrate courses and the overall student experience. The basic structure of Moodle™ had a limited repertoire of roles and permissions that neither reflected the way in which Open University courses organized themselves nor did it fully support the

organizational structures that linked those courses into coherent programs (see Sclater, 2008). Whilst these precise arrangements are particular to the OU, each technological platform has inscribed in it a set of notions about teaching and learning and each institution has its own individual ideas about how teaching and learning should be conducted (see Jones et al., 2009; and for a full case study at another Open University (OUNL), see Hermans & Verjans, 2009).

Lock-in, Contingency and Planning

The starting conditions for a change in infrastructure are rarely clear cut and they usually build on existing systems. The Open University had adopted FirstClass® computer conferencing as a tool for discussion and email and by the time of the changeover to Moodle™, FirstClass® was deeply embedded in the institution and it was obvious that disengagement from FirstClass® would take between 18 months and 3 years. Initially lock-in was observed because many of the OU courses were so dependent upon FirstClass® conferencing and courses had written FirstClass® into their course materials and embedded it at a detailed level. In reality it is only in 2010 (5 years later) that the OU is finally ready to deploy a new email system, part of a wider adoption of Google™ Apps, to replace student FirstClass® email accounts.

The planning for the new VLE was accompanied by changes in senior personnel including the appointment of a temporary Director prior to the appointment of a VLE Director for a fixed term linked to the implementation of the VLE program. It was in the period when the temporary Director was in place that the move towards the crucial decision to adopt Moodle™ took place. This necessarily had two effects. Firstly the new Director largely inherited a major decision that would have a significant influence on later decisions and secondly the decision was taken outside the detailed procedure for setting out the

requirements in Phase 1 of the OU VLE project. The planned approach was replaced and Moodle™ was largely selected prior to the appointment of the new Director, although the final decision took place at a Steering Group in the first week after his arrival. The process described here illustrates how contingent the decision making process is. The infrastructure developed at the OU arose out of a combination of structured decision making processes and the day to day contingencies of organisational life and we should expect this contingent element in the development of other large infrastructure projects in universities.

Institutional Limits

Following the introduction of the OU VLE, the university has continued to experiment with the integration of new web services into the university's online infrastructure, such as iTunes™ U and YouTube™. It has gone further than this in the attempt to integrate Web 2.0 technologies with the development of SocialLearn (Walton et al., 2008). The aim of SocialLearn (<http://www.open.ac.uk/blogs/sociallearn/>) is to apply Web 2.0 technologies to learning and in particular aspects of social networking. There are also universal services that influence universities but sit outside the institution's boundaries such as Wikipedia® and social networking sites like Facebook. The adoption of mobile technologies introduces these influences into the interactions of students in new ways, for example during work-based learning, and makes the boundary of the university less distinct.

This brief case study draws attention to the mediating role of the institution as it selects technologies for deployment in the university. The university puts in place a technological infrastructure, part of which is intentionally linked to the learning process, an infrastructure for learning (Guryibe & Lindström, 2009). This infrastructure is not easily changed and the selection of technologies that are central to the infrastructure brings with it an implicit set of decisions designed in to the

system regarding pedagogy and the organization of learning. Finally the kinds of technology that are emerging are of a kind that disrupts the organizational boundary of the university. Universal service infrastructures and cloud computing allow some interactions that are key to learning to reside beyond institutional borders.

NEXT GENERATION LEARNERS

In this section we review some of the literature concerning learner use of technology produced or referenced by two communities, namely researchers in networked and mobile learning. They share many theoretical assumptions and methods, but they have separate conferences (chief among them being Networked Learning and mLearn) and do not habitually refer to the work of the other community. A novel contribution of the chapter is that we bring the research together here for the purpose of abstracting and critiquing key findings relating to learner experience in relation to conceptualizations of learner generations. We believe that these findings have implications for how educators and institutions should create the conditions for appropriate learning.

Learners in a Networked World

When students arrive at university they have developed a variety of practices related to learning and the use of digital and networked technologies. The availability of good broadband network access is becoming nearly universal in advanced industrial countries as are the various devices, laptop computers, mobile devices, etc., connecting to these networks. Because the world that most young people grow up in is filled with new technology, it has become a commonplace to ask whether this new environment is having profound, identifiable and universal impacts on young people. Two of the most common ways to describe the new generation of young people are

as the Net Generation (Tapscott, 1998, 2009) and Digital Natives (Prensky, 2001a, 2001b).

As a result of the impact of these terms there is a growing literature that is critical of the Net Generation and Digital Native arguments. There is literature based on empirical research (Bullen et al., 2009; Hargittai, 2010; Jones et al., 2010; Kennedy et al., 2008; Pedró, 2009; Selwyn, 2008) and a smaller number of critics who have taken a more theoretical stance (Bayne & Ross, 2007; Bennett et al., 2008). The research demonstrates that students in advanced industrial countries are far from homogenous in their response to new technologies (see Hargittai, 2010, Jones et al., 2010, and Kennedy et al., 2008), whilst Bayne and Ross (2007) suggest that there is a paradox in the debate because each person is said to be fixed in a generational position but older people are still expected to change and become more like the young.

Prensky has argued that there is a distinct generational boundary and that young people have:

... not just changed incrementally from those of the past, nor simply changed their slang, clothes, body adornments, or styles, as has happened between generations previously. A really big discontinuity has taken place. One might even call it a “singularity” – an event which changes things so fundamentally that there is absolutely no going back. (Prensky, 2001a, p.1)

The generational argument that arises from both the writings of Tapscott (1998, 2009) and Prensky (2001a, 2001b), suggests that a whole generation of students has been affected by their immersion since birth in a world infused with digital and networked technologies. They suggest that it is technological immersion that causes a change in the entire generation of young people in relation to technology and in relation to a range of other activities including learning. Tapscott for example argues that the Net Generation has a tendency towards collaboration:

In education they [the Net generation] are forcing a change in the model of pedagogy, from a teacher-focused approach based on instruction to a student-focused model based on collaboration. (Tapscott, 2009, p.11)

More recently Tapscott and Williams have argued for a radical shift towards collaborative learning, understood as social learning (Tapscott & Williams, 2010, pp.18-21). The empirical research describing the Net Generation suggests another way of understanding the relationship in which the developments in digital and networked technologies allow for, or afford, different patterns of engagement with technology and learning. The way student agency affects engagement with technology has been investigated in a developing economy in which access to technology is not as universal or unproblematic as in advanced industrial settings (Czerniewicz et al., 2009). In this view technologies do not force any particular change, rather they define the range of choices that can be made. For example, students suggest that the new technologies can be distracting when they are working (Jones & Healing, 2010a). Agent driven notifications appear on screen while the students work with multiple applications open at the same time, with some providing educational and work related support whilst others are related to the student's social life and leisure. Students are not passive in response to this tendency to distraction and indeed they actively choose to follow their own strategies for dealing with this technology driven phenomenon (Jones & Healing, 2010a). Choice is not only concerned with the individual student and their relationship with technology because, as we pointed out in the previous case study, universities are also making choices.

We have argued that students are being described as different from their teachers in generational terms and we now go on to relate these arguments to the suggestion that the university as an institution is threatened by Internet based

technologies. In these arguments change is not conceived of as a choice, it is described as inevitable:

Universities are losing their grip on higher learning as the Internet is, inexorably, becoming the dominant infrastructure for knowledge—both as a container and as a global platform for knowledge exchange between people—and as a new generation of students requires a very different model of higher education. Many people have written about this topic, in EDUCAUSE Review and other publications. The transformation of the university is not just a good idea. It is an imperative, and evidence is mounting that the consequences of further delay may be dire. (Tapscott & Williams, 2010, p.18)

Bennett et al. (2008) have argued that this kind of discourse resembles an academic 'moral panic' because it restricts critical and rational debate. Moral panic is a term that describes conditions in which an identified group in society is placed in a media spotlight and described in sensationalist terms as a threat to social values and norms. The Net Generation of Digital Natives is identified in this way and they are identified as the cause of fundamental change in universities.

A powerful force to change the university is the students. And sparks are flying today. A huge generational clash is emerging in our institutions. (Tapscott & Williams, 2010, p.29)

Tapscott and Williams argue that it is a generational clash that is a major cause of university transformation.

Bates (2010) has argued that collaborative learning is a long standing aim of educational reform and that: 'The interesting question is not what universities should be doing, but why it isn't happening.' (Bates, 2010). He goes on to question the underlying idea that the problem in Universities is the 'obstructive, non-market-based business

models.’ (see Tapscott & Williams, 2010, p.29). Tapscott and Williams suggest a neo-liberal market oriented re-organisation of universities whereas Bates identifies cost cutting and resource limitation as organisational factors that restrict the capacity of universities to change. Bates’ criticism focuses on three main points:

1. The ‘new’ constructivism identified by Tapscott and Williams is not in fact new.
2. That constructivist methods require staff student ratios that have been eroded in cost cutting drives for efficiency in universities.
3. That privatization would harm some of the most basic and essential functions of university (e.g. knowledge creation and autonomy).

Bates argues that the future of university provision is a choice not a technological requirement, and that while technological change can help in the reform of university teaching and learning, resistance to change arises more from issues of funding, organization and vision than it does from a non-market form of organization. We have argued above that design has an institutional aspect through the design of infrastructure and infrastructures for learning specifically. We find no evidence that a new Net Generation of Digital Natives are forcing change on institutions, nor that the pressures for change suggest a neo-liberal market response. Pressures for change have a political and ideological source and if there are organisational constraints restricting the ability of universities to design new models of learning, such as collaborative learning, then they are more likely to be resource constraints and the reduction of staff student ratios than a non-market model of university organization.

Learners in a Mobile World

The questions implied in the above analysis are to some extent echoed in the concerns of educators and their institutions when it comes to the

challenges posed by mobile learning: ‘Is change inevitable?’, ‘Are Digital Natives causing fundamental change in universities?’, ‘Is there a generational clash between teachers and learners?’. Although mobile technologies have been around a long time, their impact on university education is much more recent, and the possible extent of this impact is only just being imagined. The use of mobile technologies in teaching and learning began as a set of discrete research projects, followed by a wave of more widespread adoption by a limited number of institutions, some of which have issued laptops, phones, mp3 players or tablet computers to whole cohorts of students. The current situation in the UK and in less developed economies, such as South Africa (Czerniewicz et al., 2009, pp. 77-81) is that the mobile phones owned by the majority of students, due to their improved functionality, are becoming a feasible tool for mobile learning, largely obviating the need to purchase special devices (although this does not hold true for more technologically advanced mobile learning). However, the ‘critical mass’ of owners of mobile devices may not translate automatically into use. Amongst English students the use of advanced features of mobile phones, such as email and Internet access shows a relationship with age and the youngest students are the most active, although use of these advanced features is not as common as the ownership of devices enabled with these functions (Jones & Cross, 2009; Jones & Hosein, 2010). Nevertheless in the near future we can expect a variety of mobile devices, including laptops, smart phones, tablets and slates to challenge desktop access. Recent surveys in the US show increasing ownership and use of mobile devices with approximately 50% of students owning such devices and most of this group (80%) using the devices to browse the Web and send email (Smith & Borreson Carruso, 2010).

In parallel, there is evidence of a growing expectation among web users that content is accessible on a mobile device and that mobile interaction is supported, fuelled by the rise in mobile services

such as mobile banking (Butcher, 2010). Internal data collected by The Open University show a steady and significant increase over the past couple of years in mobile access to a website containing information and study resources for students. This suggests a learner-led demand for at least one form of mobile learning. Use of mobile technologies will depend on the development and deployment of mobile educational resources by universities as well as growing student access to mobile devices (Sheehan, 2009). A secondary consideration will be the way in which academics and course teams build in requirements for the use of mobile technologies into their courses. Furthermore, it will also depend on the provision of universal services, such as Wikipedia®, Google™ and location aware applications, optimised for mobile use.

Research in the field of mobile learning has changed over the past couple of decades as the early emphasis on design of educational software for portable devices evolved towards socio-technical support for learner mobility (Kukulska-Hulme et al., 2009). This shift was brought about by the proliferation and increasing acceptance of mobile devices as everyday tools supporting life, work, informal learning and leisure, along with developments in technology and infrastructure enabling wireless access to the internet and more diverse channels of social communication including social networks. Mobile access is fuelling the explosion of social media and contributing to the blurring of boundaries between formal and informal learning (Pettit & Kukulska-Hulme, 2007).

The availability of thousands of free and inexpensive ‘apps’ (small applications for smart-phones) is again changing the nature of mobile learning, marking a return to imaginative software design whilst also confirming the importance of users as a key influence on the future direction of mobile learning. Although educators would like to claim that pedagogical considerations shape the design of mobile learning, and indeed in many cases they do, in reality it is difficult to ignore the fact that the mobile marketplace is shaping user expectations and behaviours. There is also

a strong push from technology firms forging ahead with new personalized, location-aware and context-aware services that are likely to capture users’ imaginations and arguably will meet some of their needs sooner than what can be provided by universities (Educause, 2009).

Mobile learning could remain informal and separate from other forms of networked learning but the argument for its integration into university curricula may be supported by investigations of how young people are adopting personal devices as indispensable tools enabling them to remain in perpetual contact with friends and acquaintances, especially in countries such as Finland and Japan where a mobile culture first became pervasive (Ito, Okabe & Matsuda, 2005; Kasesniemi & Rautiainen, 2002). Currently English university students have not adopted the practices of nomadic workers and are still using mobile technologies in a limited number of quite traditional physical spaces, such as student study bedrooms (Jones & Healing, 2010b). In those university programmes where communication and collaboration are important, the added dimension of mobile interaction may soon be considered essential.

Mobile learning among young people is generally reported as part of formal ‘designed learning’ projects rather than learner-led activity arising from learners’ own requirements (Kukulska-Hulme, Traxler & Pettit, 2007). However, Bradley and Holley (2010) report that “many students are using whatever mobile phone they have for a wide range of learning activities” (p. 238). Mobile phone use has also been researched in the broader context of ‘learner voice’ case studies that try to elicit learner perspectives on their learning experience including use of technology:

An overwhelming feature that emerged from the case studies was the fact that technologies appeared to be integral to learning for all the students, irrespective of their background, prior IT expertise, learning preferences or subject discipline studied. (Conole, 2008, p.126).

Research with older or mature learners confirms that within more advanced age brackets there are groups of mobile users that can be identified as ‘innovators’ and ‘early adopters’ (Rogers, 2003), namely those who are at the forefront of change as evidenced by their active use of social networking and mobile technologies to advance their learning (Kukulska-Hulme & Pettit, 2006; Kukulska-Hulme et al., 2009; Pettit & Kukulska-Hulme, 2007). These groups of individuals are making use of new tools within a particular period of time, ahead of their peers. Beyond social contact, typical uses include accessing fresh content, gathering local information and becoming visible as creators and producers of resources which may be shared with others.

What are the implications for university teachers? Mobile learning challenges teachers to examine how mobility relates to their teaching aims, methods and subject matter. Mobile devices are also extending networked learning into new physical environments and enabling more experimental learning designs in a range of new locations outside the traditional, and even the virtual, classroom. This poses real challenges to educators in terms of:

- Reduced control over the physical location and setting in which learning takes place
- Potential to increase awareness of remote activity in virtual and off-site settings, for example through learner activity logging
- Understanding the possible new learning goals and outcomes offered by mobile learning
- Usability and accessibility issues that continue to be reported on the ground, despite the rhetoric from highly confident or technically-minded users that devices are now ‘intuitive’ and no longer pose such problems
- Limited access to appropriate devices, reported by teachers (Mifsud & Smørdal, 2006), a situation that is repeated in universities and should be understood in the context

of many established users being content with their existing phone – until they consider mobile learning

- Ethical considerations associated with new activity such as learner-generated content created on mobile devices, where spontaneous actions may have unintended consequences for learners, teachers and institutions

In summary, the proliferation of mobile technologies is likely to have a significant impact on design for learning in the medium to long term, however current student expectations are not pushing teachers to work on innovative designs. For some time yet, the use of mobile devices will remain a complementary activity or an alternative way to access course materials and for students to make contact or collaborate with other students. The development of location-aware and context-aware applications is still largely in the realm of research, although the thinking that this generates around the design and use of learning spaces can benefit all who are interested in looking to the future and considering what new choices may present themselves. Mobile learning enables teachers to design for learning beyond the boundaries of their institution, but they will require good advice and examples of how this can be done.

Implications for Design

We have established the broad institutional and external factors affecting choices that university teachers make about their use of networked and mobile technologies for teaching and learning, as well as some specifically human factors that relate to usability, accessibility, ethical issues and feelings of control. We have shown in our case study that the provision of a technological infrastructure at university level has a mediating role with a significant influence on learning practices. The university infrastructure which is intentionally linked to the learning process provides an infrastructure for learning (Guryibe & Lindström,

2009). This infrastructure for learning incorporates a set of design considerations affecting pedagogy and the organization of learning. Externally universal service infrastructures and cloud computing threaten to disrupt the university's organizational boundaries.

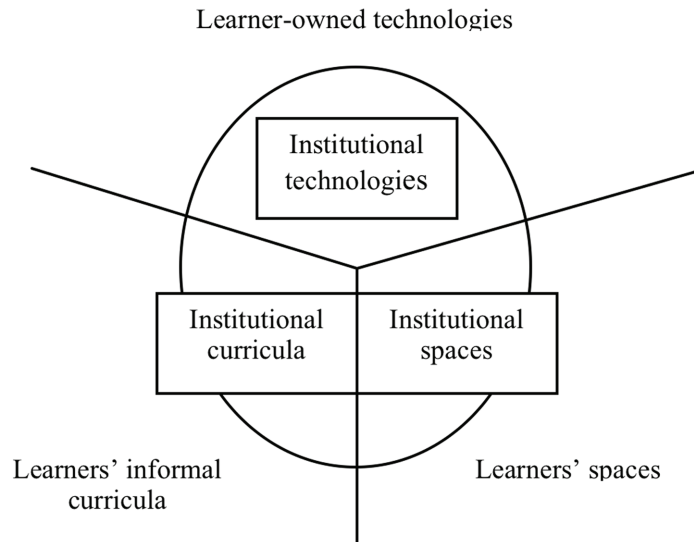
We have found that there is no strong imperative from students that would suggest the need to design for a different 'generation'. Nevertheless, teachers need to understand emerging student practices with technology as these give indications of what is becoming common and accepted, and will be particularly relevant to how students may approach learning tasks that have been set. The implications for design are in terms of defining the next generation of designs that take account of infrastructures for learning and student practices with technology but are not driven by these considerations alone. We would argue that learning spaces are becoming a key element of design for learning (Jones & Dirckinck-Holmfeld, 2009). JISC (2009) has produced a valuable guide to the design of physical teaching, learning and social space, to accommodate and make best use of mobile and networked technologies in attractive and flexible ways. In our own work we found during a follow up investigation reported in Jones & Healing (2010b) that the introduction of a new zone on a campus university, specifically designed with wireless access, with comfortable informal seating and 24 hours access, led to an increase in students' use of mobile devices in the following academic year. There are also numerous publications pertaining to the design of virtual space, including in immersive environments such as Second Life®. We would argue that in reality, teachers seldom have the opportunity to design the spaces they would like to teach in, however physical and virtual spaces designed for them in a flexible way can allow teachers to adapt and change what they find in the learning space. This implies a focus on the institutional provision of both physical and virtual learning spaces that make the most of the affordances of new mobile

and network technologies. This may involve some additional effort and planning at an institutional level. For teachers, the effort of adaptation could be more acceptable if setting up a learning space were to become a self-evident and valued stage in course and programme design, and individual teaching sessions. This may require a change of attitude and different practices on the part of teachers, learners and institutions.

Spaces only make sense when considered in relation to what is made of them, people's behaviours and appropriation of space, therefore learners' activities and the technologies they make use of are the other key elements. Space can be distinguished from place, the lived-in environment constituted by students and teachers from the available physical and virtual resources (Jones & Dirckinck-Holmfeld, 2009). Students may bring devices with them or access networks and resources within the learning space and beyond it. From this perspective, when designing for learning with mobile and networked technologies, teachers and institutions need to consider the following in an integrated way (see Figure 1):

1. Learning spaces (in the institution and beyond)
 - What are students expected to do for their learning and where can this take place?
 - How is use of learning spaces connected with use of time, e.g. will students return to the space between formal sessions?
 - What are the organizational boundaries and what is permitted or feasible within the institution and beyond?
2. Learners (in formal and informal settings)
 - There is no evidence of a generational step change, but what kinds of changes in learner practices are taking place?
 - How can spaces and technologies be used to elicit feedback from students

Figure 1. Conceptualizing design for mobile and networked learning



on their learning activity? (e.g. logs of activity, visualisations of learner networks, etc.)

- What is known about students' experiences and expectations based on their previous use of technology in life and learning?
- 3. Technologies (institutionally-provided and learner-owned)
 - What level is appropriate for the design of a technological intervention: university, programme, course or class?
 - How flexible and adaptable is the design of the technological environments where learning is expected to take place?
 - Is there any foreseeable conflict between various technologies being proposed in the design, including more traditional tools and media?

It should be understood that pedagogical design will involve several levels of intervention, involving whole institutions and the design of learning

infrastructure, through to intermediate levels in terms of the design of curricula and programmes of study in departments and faculties, right down to course teams and individual practitioners who design the tasks and quotidian interactions of particular modules and courses. It also seems important to state that by building continual research on student practices with technology into the practice of teaching, we can create environments where students and teachers are in ongoing dialogue and this in turn has the potential to inform and transform institutional strategy. Thomas (2010) argues that although design of learning space is replacing the previous emphasis on content and outcomes in course design, nevertheless, "... 'the structure of the learning space' cannot be the point of departure in the planning process" (Thomas, 2010, p.509). For him, the important part is planning for an activity that can be described as "an adaptive enterprise", such that the structure of the learning space becomes "a function of the adaptive complex system that it serves" (ibid, p.509). He does, however, acknowledge that this is a daunting requirement. It seems to us that in practical terms,

university teachers will want to work with more concrete ways of thinking about design.

FUTURE RESEARCH DIRECTIONS

Students come to university with habits of social engagement mediated by digital networks and they are already familiar with a number of universal services useful in education, such as search engines (e.g. Google™) and Wikipedia®. When they arrive at university students are met by an institutional infrastructure for learning that has been specifically designed to support learning. Because networks and mobile technologies allow students to construct their personal learning environments using a range of services in a variety of spaces we cannot assume that learning will take place only in the buildings and settings that have been designed for that purpose. Many areas of the University will remain the same, such as the lecture theatre, seminar room and library, but they will be used in different ways, and social or recreational areas (café, leisure facility, etc.) are transforming into places for digitally enhanced learning. Universities already struggle with issues around mobile Internet access during classes. Some universities try to block access whilst others encourage it. Research will need to analyze these changes and provide timely advice for educators and educational institutions about the ways that student learning is changing and the kinds of technological provision that the university should be making.

The complex task of design remains one that has to focus on those features of mobile and networked learning environments that can be designed without prescribing the detailed interactions that teachers and learners may undertake in these settings. The university will need great flexibility to accommodate the variety of technology-related demands it will face. The convergence of mobile and networked digital devices, and the changes in the skills required for educational de-

sign, mean that there is a constant need to re-think and revise design approaches. From the work we have reported we have identified three key issues for future research.

Contexts for Learning

Mobile devices extend networked learning into new physical environments and enable designs for learning in a range of new locations beyond the classroom. Networked learning took learning beyond known contexts, and mobile technologies take this further by converging mobile telecommunications with wireless and broadband Internet access. These technologies are in one sense an extension of the earlier promise of the Internet and the Web, but education and learning is still largely located in institutions and embedded in practices that are slow to change. These factors may slow the pace, and restrict the scope of changes associated with networked and mobile learning. Research needs to explore both the ways new mobile technologies are being used in the wild and the ways in which the new technological possibilities interplay with institutional and social constraints. For the new technologies to lead to productive outcomes for education and learning we need to know more about the ways learners constitute their own contexts for learning in the new mobile networks.

Space and Place

Fostering a sense of place (Cresswell, 2004) in networked learning environments may be necessary to develop a social and emotional context which is able to sustain learning. Students participating in a networked learning environment are simultaneously situated at a real point in time and space and also displaced from that physical point in a virtual space in the network. Whilst students' learning spaces are never completely disembedded or separated from their off-line activities and spatial locations, they are displaced. The flexibility

of virtual spaces requires students to engage in a process of place-making. The adoption of a distinction between designed space and enacted place has theoretical and methodological implications. Firstly, it influences the kinds of interests researchers pursue in their research and secondly, it will affect the methods that are used to understand the students' experience of place within networked and mobile learning environments. The concept of place as distinct from space can improve the design of networked learning environments and it will be important to understand the way students and teachers experience designed spaces and the potentials that exist for them to constitute their own places.

Levels for Design

Research will also need to distinguish between the different levels at which design for learning can be realized. There is a strong tradition of research into classroom activity, the design of resources and materials and the design of various tools and devices. There has been less emphasis on the way intermediate structures can be designed, such as institutional infrastructures for learning, and the overall design of learning spaces. We suggest that the meso level of design may be critical in the deployment of networked and mobile technologies. At its simplest the meso level can be thought of as being intermediate between small scale, local interaction and large-scale policy processes. The meso level can be characterized as the level where bottom-up meets top-down. We think that it is possible to use the distinctions between macro, meso and micro levels in an analytic way which identifies social practice as the locus in which broader social processes are located in small group activity. We think further research on the ways mobile and networked technologies can be designed for use in Higher Education will depend on a strong sense of how the different levels of the educational system interact with the new technologies.

CONCLUSION

Design in mobile and networked learning environments is notoriously difficult because the location, connections and context of the learner are outside of the designer's control (Beetham and Sharpe, 2007). Design cannot be direct and the spaces and activities that are the product of design will be interpreted flexibly by the students and teachers who inhabit the design. Nevertheless design is necessary at various levels. Design needs to take account of:

- The kinds of students that are entering university and how exposure to networked and mobile technologies is changing their experience of learning;
- The infrastructures beyond institutional control and infrastructures for learning that can be designed (Guryibe & Lindström, 2009);
- The specific tools, resources and artifacts used for learning;
- The kinds of tasks and activities that we expect learners to engage in for their learning (Goodyear et al., 2001).

We conclude that design should not be based on a supposed generational gap between teachers and students, nor is there an identifiable generational pressure for change, but there are age-related changes taking place that we ignore at our peril. The younger students are, in advanced industrial economies, the more likely they are to be using social networking, advanced features on their mobile phones, and editing and uploading multimedia files. The older students are, the less likely this is to be the case. There is no singularity or sharp generational divide and there are minorities of students in all age groups that engage in limited or advanced ways with technology. Design has to cope with this variation and include minorities as well as the increasing numbers of younger students who are more accustomed to the new technologies.

The Open University Learning Design Initiative (Conole, 2010) is an example of good practice in fostering a holistic approach to designing for learning, but many institutions will find that their entrenched infrastructures will continue to hamper integrative thinking in design. Furthermore, there is little shared experience of how evolving use of technology in physical and virtual space impacts on design. This is why we have argued that learning spaces should become a new focus of designs for learning, and an important aspect of future research in this area.

Design will take place in an increasingly uncertain policy context in which the boundaries between public and private provision will be subject to change. Firstly, cloud computing is outsourcing institutional provision from the university and secondly, the financial crisis has led some states to begin to withdraw from social support for Higher Education and an increased emphasis on the development of private provision. Within this shifting landscape, the impact of mobile and networked technologies in Higher Education is increasing. Often thinking about mobile technologies has been restricted to small handheld devices connected by broadband mobile and wireless networks. Networked learning in contrast has focused on the distribution of learning via the Internet and Web. Increasingly these two areas of interest converge as devices become hybrid (e.g. iPad, Android tablets) and are able to connect to the Internet and Web seamlessly through both mobile telecommunications and wireless Internet. The challenge will be to design for learning in contexts over which educators have increasingly limited control.

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KEY TERMS AND DEFINITIONS

Conceptual Tools: In this chapter, the term refers to paper-based analytical instruments that help teachers think through their teaching approach and plan various aspects of teaching.

Digital Natives: People who have grown up with, and become familiar with, digital technology such as computers, the Internet, mobile phones and MP3s. They are usually contrasted with digital immigrants, who were born before the existence of digital technology and have adopted it later on in their lives. Generally used interchangeably with Net Generation and Millennials.

Hybrid Space: The combination of virtual and physical space, for example using geographical coordinates to represent real world events as they happen, on a digital map shared online or through mobile devices.

Infrastructure: Services or facilities which support an operation, which at a high level might include telecommunications, networks, servers, databases, cloud computing. Infrastructures are already in place, ready-to-use, completely transparent and not requiring consideration. They are socio-technical systems, which are reliant on complex organizational practices for maintenance and for making the infrastructure meaningful.

Infrastructure for Learning: A set of resources and arrangements – social, institutional, technical – that are designed to, and/or assigned to, support a learning practice (Guribye 2005).

Neo-Liberal: A market driven approach to economic and social policy that emphasizes the role of private business and minimizes the role of social institutions and the state. It is part of an internationally prevailing ideological paradigm that uses the language of markets, economic efficiency, consumer and individual choice.

Net Generation: Also known as the Millennials, members of an age cohort that have birth dates which fall between the mid 1970s and the early 2000s. It is claimed that this age cohort forms a generation which is defined by its exposure to networked and digital technologies. It is also claimed that they adopt a collaborative or participative approach to learning. Generally used interchangeably with Digital Natives and Millennials.

Social Network: A social structure composed of nodes that can be individuals, groups or larger bodies, connected (tied) together on the basis of interdependencies such as, kinship, common interest, status, acquaintanceship, friendship, financial flows, etc.

Supported Open Learning: The Open University's style of distance learning, enabling students to learn in their own time, at home or wherever they choose, undertaking set activities and assignments using supplied resources with regular and systematic support from a tutor and a community of other learners.

Virtual Learning Environment (VLE): An Internet or Web-based software system designed to support teaching and learning in an educational setting, providing a collection of tools for assessment, communication, the delivery of content, group work and the administration of student groups. Also known as Learning Management System (LMS), Course Management System or Managed Learning Environment.